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Author(s): T. Kim Mellen, E. Charles Meslow and R. William Mannan

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SUMMERTIME HOME RANGE AND HABITAT USE OF PILEATED WOODPECKERS IN WESTERN OREGON

T. KIM MELLEN,¹ Cooperative Wildlife Research Unit, Oregon State University, 104 Nash Hall, Corvallis, OR 97331

E. CHARLES MESLOW, U.S. Fish and Wildlife Service, Cooperative Wildlife Research Unit, Oregon State University, Corvallis, OR 97331

R. WILLIAM MANNAN, School of Renewable Natural Resources, 214 Biological Sciences East Building, University of Arizona, Tucson, AZ 85721

Abstract: Current allocations of habitat for pileated woodpeckers (*Dryocopus pileatus*) on National Forests in the western United States may be inadequate because of previous methods used to calculate this species' home range. Hence, we used radio telemetry to determine home ranges ($n = 11$) and habitat use ($n = 14$) of pileated woodpeckers in the Coast Ranges of western Oregon during the summers of 1982–85. Home ranges for individual adult birds, after young had fledged, averaged 478 ha. Home ranges for pairs were larger. Home ranges were larger than those reported in other studies. Pileated woodpeckers preferred ($P < 0.05$) forest vegetation classes that were older than 40 years and deciduous riparian habitats for foraging and other diurnal activities more than classes that were younger than 40 years. Nesting and roosting occurred only in forest stands older than 70 years. The amount of foraging habitat within the home ranges averaged 310 ha; whereas the amount of nesting and roosting habitat averaged 225 ha. Because pileated woodpeckers forage in immature forests, they may not be good management indicator species for mature and old-growth forest habitats.

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Pileated woodpeckers use large snags (standing dead trees) and defective live trees for nesting, roosting, and foraging; and downed logs for foraging (Bull and Meslow 1977, McClelland 1979, Mannan et al. 1980). These components are prominent structural elements of mature and old-growth Douglas-fir (*Pseudotsuga menziesii*) forests of western Oregon (Cline et al. 1980, Franklin et al. 1981). Mature forest stands usually support higher densities of pileated woodpeckers than younger forests in western Oregon (Mannan et al. 1980).

The pileated woodpecker has been identified by the U.S. Forest Service (USFS) as a management indicator species of mature forest habitats on National Forests in the Pacific Northwest Region. However, most information available on their habitat use in the region has been collected from forests east of the Cascade Mountains (Bull and Meslow 1977, Bull 1980, Madsen 1985). Home range and habitat use on the west side of the Cascade Mountains may differ from other areas because forest types and productivity differ (Franklin and Dyrness 1973). Douglas-fir is avoided as a nest tree on the east side where other tree species are available for nests (McClelland 1979, Madsen 1985, Bull 1987), but it is the dominant species in west-side forests.

The current USFS guidelines for habitat area allocations for pileated woodpeckers may be inadequate because they are based on home ranges extrapolated from density estimates (Bull and Meslow 1977). Inadequate allocations could have serious implications to the viability of the species in the western United States. Furthermore, because the pileated woodpecker is an indicator species, its proper management may aid the viability of other species using similar forest habitats.

Radio telemetry allows more accurate assessment of home range size, but the only estimates of home range size for pileated woodpeckers based on radio-telemetry data are for bottom land habitat in Missouri (Renken and Wiggers 1989). That ecosystem is very different from Douglas-fir forests of the Pacific Northwest. Consequently, we wanted to provide resource managers with more accurate habitat information to manage populations of pileated woodpeckers in forests of the Pacific Northwest. Herein, we describe summer home range and habitat use of pileated woodpeckers in the Coast Ranges of western Oregon as determined with radio telemetry.

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¹ Present address: Mt. Hood National Forest, 2955 N.W. Division Street, Gresham, OR 97030.

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STUDY AREA

We worked in the central Coast Ranges 15–30 km west and southwest of Corvallis in Benton and Lincoln counties, Oregon. Lands were managed or owned by Siuslaw National Forest, Bureau of Land Management, City of Corvallis, and private individuals. The area was part of the western hemlock (*Tsuga heterophylla*) vegetation zone (Franklin and Dyrness 1973). Forests were dominated by subclimax stands of Douglas-fir; climax stands of western hemlock do not routinely develop because of natural disturbances and logging (Franklin and Dyrness 1973). Most of the area was managed for timber production.

The area received 150–300 cm of precipitation annually, mostly during winter and primarily as rain (Franklin and Dyrness 1973). Winters were cool and summers were warm. January mean minimum temperatures ranged from –2.5 to 2.5 C, and July mean maximum temperatures ranged from 22.5 to 27.0 C. Elevation of the study area varied from 100 to 1,250 m, with topography characterized by peaks and ridges with steep slopes and many deep valleys cut by streams.

METHODS

We included in our analysis the estimates of home range size provided by Mannan (1984), but reanalyzed his data on habitat use. Mannan (1984) worked within the same study area in 1982 and found that home range size of pileated woodpeckers in western Oregon ranged from 408 to 549 ha and that forest stands ≥70 years of age were used as sites for foraging. However,

Table 1. Forest vegetation classes that describe habitats used by pileated woodpeckers in western Oregon, 1982–85.

Age (yrs)	Description ^a
0–15	Clear cut, seedlings and/or saplings, managed
16–40	Saplings and small poletimber, managed
41–70	Immature, poletimber and/or small sawtimber, managed
71–100	Mature, small and/or large sawtimber, managed and unmanaged
100–200	Older mature, large sawtimber, unmanaged
> 200	Old-growth forest, unmanaged Deciduous riparian, primarily red alder (<i>Alnus rubra</i>) and bigleaf maple Non-forest land (e.g., agricultural land, meadows, lakes)

^a Stands were dominated by Douglas-fir with minor elements of western hemlock, western redcedar (*Thuja plicata*), and hardwoods.

he based his conclusions on only 3 birds, and his analysis of habitat use within home ranges suffered from problems associated with autocorrelation. We redefined vegetation classes and reassigned each of Mannan’s locations to the appropriate vegetation class. Mannan’s (1984) data were then analyzed together with data collected from 1983 to 1985.

We described 8 forest vegetation classes (Table 1). Classes were divided by age because it is an important criterion for timber management, and the data were available from the land owners or managers. Deciduous riparian and non-forest classes also were described. We used type maps of forest stands from the Bureau of Land Management, USFS TRI system, and Starker Forests Inc. to classify and map vegetation classes. The type maps provided stand age and tree species composition. We determined classification of the few stands not defined on type maps by visual estimation in the field. We compared tree size, density, and species composition to the same characteristics in stands of known age. We also counted rings in stumps in adjacent clear cuts when possible. We did not measure stand characteristics. The area encompassed by each vegetation class within each home range was measured with a digitizer.

We located forest stands used by pairs of pileated woodpeckers during April–May by eliciting responses to tape recorded pileated woodpecker calls and drumming and by listening for unsolicited vocalizations from the extensive net-

work of logging roads. We also searched for excavations made by foraging pileated woodpeckers in snags. We searched stands used by the birds for freshly excavated cavities. We confirmed the cavities as nests only when we observed an exchange of incubation duty between members of the pair or when we saw or heard young in the cavity. Roosts were located by following radio-marked birds to the roost in the evenings.

We trapped adult pileated woodpeckers at 13 nests and fitted them with radio transmitters (Wildlife Materials, Inc. or AVM Instrument Co.) using a backpack harness of teflon tubing. Transmitter packages including transmitter, battery, antenna, acrylic, and harness weighed approximately 8 g ($\leq 3\%$ body mass of the birds). To avoid causing nest abandonment, we trapped birds after young had hatched, or after ample time (30–35 days) was allowed for incubation. Most nest snags could not be climbed safely so we climbed adjacent trees and used a long pole to place a dipnet frame with mist-net webbing over the cavity. We trapped birds as they left the nest to exchange brooding duties or after feeding young. With 2 exceptions, both members of each pair were trapped and equipped with transmitters.

We attached radio transmitters to 24 pileated woodpeckers (including those reported in Manan 1984); however, problems were encountered with many of the transmitters. Apparently the woodpeckers broke or bent the transmitter antennas, which greatly reduced the signal range and made monitoring some birds difficult or impossible. This reduction of transmitter range began within a few days to several weeks after transmitters were attached; thus, a number of birds were located only sporadically, and these data were not included in our home range analysis. Radio transmitters fell off 2 birds, and 1 bird was killed by a predator. Adequate data were collected for calculation of home range sizes for 11 birds and for evaluation of habitat use for 14 birds.

We monitored birds during daylight for up to 3 months (maximum life of the transmitters) after the young had fledged. Most data were collected in June–July; 5 birds were monitored into August. We tracked 1 bird/day. The bird was continuously monitored and locations were recorded at 10-minute intervals. If a bird flew out of receiving range, we recorded the next

location when the bird was relocated. Each position was located on an aerial photograph on which vegetation classes were mapped. Grid coordinates, superimposed on the photograph, were recorded.

We stayed as close as possible to the birds without disturbing them so their locations could be accurately determined. Distances depended on vegetation; distances were further across clearcuts and closer in dense forest stands, but rarely closer than 50 m. We did not use fixed triangulation stations, so error polygons were not calculated. Approximately 13% of locations were confirmed by visual or auditory contact which allowed us to estimate that telemetry locations were accurate to within 100 m. Forest vegetation classes (Table 1) were assigned in the field when the location was recorded and only when the vegetation class the bird was using could be confirmed. Locations in small stands or near boundaries of stands were verified by visual or aural contact or by direction of the radio signal in relation to the boundary of the vegetation class.

We selected the minimum convex polygon, a non-statistical method, as the most appropriate model to use in calculating home range sizes. Swihart and Slade (1985) suggested using a non-statistical method when data must be collected over a short period of time and autocorrelation cannot be avoided. This was the case with our data set. Schoener's (1981) t^2/r^2 ratio was used to test independence of locations within subsets of the location data with a variety of time intervals between telemetry locations; t^2 is the mean squared distance between successive observations, and r^2 is an estimate of the mean squared distance to the geometric center of the locations. The expected value of the t^2/r^2 ratio equals 2.0 when locations are statistically independent. Subsets of our data with time intervals from 1 location every 10 minutes ($t^2/r^2 = 0.19$) to 1 location every 3 days ($t^2/r^2 = 1.46$) were tested and independence was never achieved.

We used an area-observation curve (Odum and Kuenzler 1955) with minimum convex polygon home range estimates to determine if an adequate number of locations had been collected for each bird to estimate home range size. We reported home range sizes only for birds for which the area-observation curve exhibited an asymptotic relationship (Sanderson 1966, Smith

Table 2. Home range sizes ($n = 11$) and habitats used ($n = 14$) by pileated woodpeckers during summers in western Oregon, 1982–85.

Yr	Sex	Home range size ^a (ha)	Minimum number of locations for estimate	Total number of locations ^b	Habitat use (% habitat available/% habitat used)						
					Forest habitat classes						Decid. riparian
					0–15 yrs	16–40 yrs	41–70 yrs	71–100 yrs	101–200 yrs	200+ yrs	
1985	M ^c	1056	400	550	24/2	22/2	17/6	17/40	14/27	0/0	6/23
1985	F	570	479	522	9/1	9/2	23/31	20/15	23/16	13/18	3/17
1982	M ^d	549	400	400	21/1	5/0	0/0	0/0	6/12	68/87	0/0
1985	M ^e	533	357	386	20/3	24/0	5/4	33/80	12/8	0/0	5/4
1982	M ^d	492	400	400	7/1	14/3	23/14	37/51	13/22	3/5	3/4
1983	F ^c	431	386	392	14/7	11/11	41/46	15/31	14/1	2/1	3/3
1982	F ^d	408	355	355	7/5	13/3	27/18	37/58	11/23	4/3	1/0
1985	F	363	211	335	17/2	18/6	3/4	3/6	15/17	43/64	0/0
1985	F ^c	300	452	453	18/2	14/3	13/9	28/40	17/19	0/0	10/27
1984	M ^e	293	402	454	14/4	32/9	19/23	11/44	10/16	0/0	11/5
1985	M	267	218	255	24/1	0/0	46/43	20/25	0/0	0/0	10/30
1985	F	e	e	181	27/0	0/0	42/35	21/39	0/0	0/0	9/24
1985	F ^c	e	e	163	16/8	49/0	2/1	13/40	15/50	0/0	5/1
1984	F ^c	e	e	169	26/6	4/3	17/7	39/56	10/25	0/0	4/2
Mean		478 ha									
SD		219									

^a Estimated using a minimum convex polygon.^b Additional locations that were collected did not increase home range size.^c Young present.^d Home range size from Mannan (1984).^e Home range size was not estimated.

et al. 1981, Laundré and Keller 1984). Additional locations that did not increase home range estimates were collected for some birds.

We evaluated habitat use only within home ranges. We determined use of habitats by calculating the proportion of locations in each forest vegetation class. Because the birds were able to travel to any point within their home range within the 10 minutes between recorded locations, all vegetation classes within the home range were considered available to the bird for each location. We compared habitat use to the proportion of each forest vegetation class available within the home range of the woodpeckers (Byers *et al.* 1984). Non-forested classes were not included in the calculations because they comprised <3% of the home ranges, and because pileated woodpeckers never were observed in these areas.

We calculated preference ranking based on the difference between use rank and availability rank of each forest vegetation class averaged across all birds (Johnson 1980). We used Johnson's definitions of preference and selection for discussions in this paper. Habitat preference "is a reflection of the likelihood of [a habitat] being chosen if offered on an equal basis with others," and habitats can be ranked in relative order

from most preferred to least preferred (Johnson 1980). Selection is defined as using a habitat disproportionately to its availability (Johnson 1980). The program PREFER (IBM PC version V2.0, A. M. Frank, U.S. Fish Wildl. Serv., Ann Arbor, Mich.) was used to calculate preference ranking.

RESULTS

Home Range

Home ranges averaged 478 ha with a range of 267–1,056 ha (Table 2). The largest home range, occupied by a Peak Creek male, was 85% larger than the next largest home range. This male, accompanied by at least 1 young, flew to the home range of a neighboring pair of pileated woodpeckers during 4 of 33 days of monitoring. A large area in the center of his home range was used only as a travel corridor during the observation period; however, because these excursions were frequent, they were included in the home range estimate.

Area observation curves began to exhibit an asymptotic relationship between home range size and number of radiolocations by 30–40 days after monitoring began. Estimated home range size was not correlated ($r = 0.32$, $P > 0.05$, n

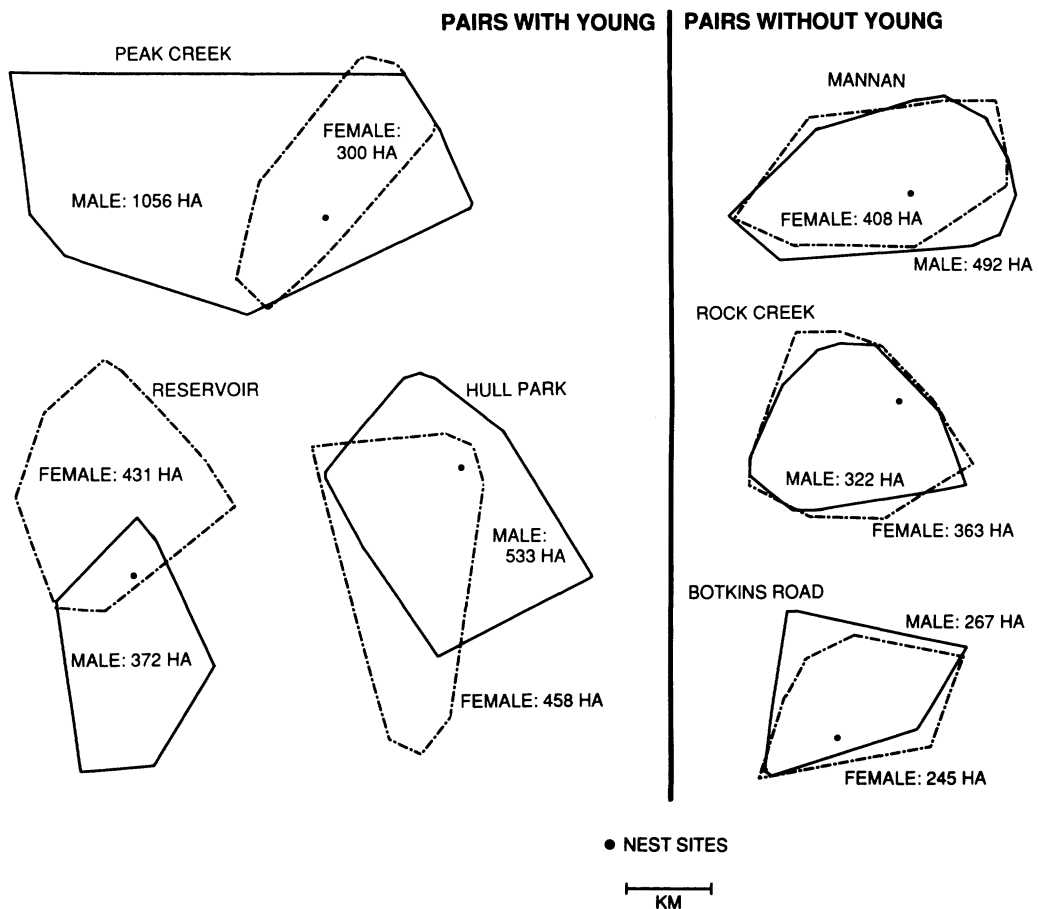


Fig. 1. Summer home ranges of 6 pairs of pileated woodpeckers in western Oregon, 1982–85. Home range data on Reservoir male, Hull Park female, Rock Creek male, and Botkins Road female were incomplete. Figure does not depict location of pairs in relation to other pairs.

= 11) with the minimum number of consecutive locations necessary to calculate those estimates. The transmitter on the bird with the largest home range functioned longer than any of the other transmitters so the greatest number of locations was collected for this bird. The much larger home range and large sample size for this bird contributed to a significant relationship ($r = 0.65$, $P \leq 0.05$, $n = 11$) between home range size and total number of locations. However, the last 150 locations for this bird did not increase our estimate of its home range size. The home range size was 78% larger than the next largest home range after only half the locations had been collected.

We observed resident pileated woodpeckers defending their home ranges. Both males and females reacted to intruding birds on the boundaries by calling and drumming. However, home

ranges of adjacent birds overlapped, ranging from 9% to 30% of individual home ranges (11–160 ha).

Home range sizes for 6 pairs of pileated woodpeckers were larger than home ranges of individuals (Fig. 1). We did not calculate combined home range sizes of males and females because of incomplete data on 4 pairs. However, our limited information indicated that home ranges of pairs with fledged young were larger than the home ranges of either member of the pair, and the home ranges of these paired males and females were not congruent (Fig. 1). Adults divided the young during foraging bouts so each was accompanied by 1 or more. The combined home ranges of paired birds without young (measured after failed nesting attempts) were only slightly larger than home ranges of the individuals (Fig. 1).

Habitat Use

We found no difference ($P \geq 0.05$) between relative preference for deciduous riparian vegetation and any forest vegetation classes older than 40 years. Forest vegetation classes less than 40 years of age were ranked as less preferred ($P < 0.05$) relative to classes older than 40 years and deciduous riparian habitat.

Deciduous riparian habitat and 101–200 year age classes were available in small amounts to most birds, and some exhibited a strong selection for these 2 habitats, using them in proportions 2–3 times greater than proportional availability (Table 2). Old-growth habitat (200+ years) was available to only 43% of the birds, and those birds that selected for old growth did not exhibit strong selection for the habitat using it in proportions <1.5 times the proportion of availability (Table 2).

Nests and roosts were located only in habitat classes older than 70 years; one roost was located in a large (73 cm dbh) big leaf maple (*Acer macrophyllum*) in a deciduous riparian area (Table 3). Nest trees ($n = 18$) averaged 71 cm diameter at breast height and ranged from 40 cm to 138 cm. Roost trees ($n = 15$) averaged 112 cm diameter at breast height and ranged from 40 to 208 cm.

Within the birds' home ranges, the amount of vegetation classes older than 40 years of age averaged 310 ha, or 65% of the available habitat, and ranged from 147 to 571 ha. Forest vegetation classes older than 70 years averaged 47% of home ranges. The area of these older vegetation classes within the home range averaged 225 ha and ranged from 55 to 405 ha.

DISCUSSION

Home Range

Reported home range sizes are for individual pileated woodpeckers during summer after young had fledged or nesting attempts had failed. Because we collected data only during this short time frame, home range sizes reported here are undoubtedly minimal estimates of actual year-round home ranges.

The summer home ranges we measured in this study were larger than breeding territories estimated in northeastern Oregon (130–240 ha, Bull and Meslow 1977), winter home ranges in Georgia (70 ha, Kilham 1976), and spring and summer territories in Missouri (53–160 ha, Renken and Wiggers 1989). Foraging areas in Mon-

Table 3. Pileated woodpecker nests ($n = 18$) and roosts ($n = 15$) located in each forest vegetation class in western Oregon, 1982–85.

Forest vegetation class	No. of nests	No. of roosts
≤70 yrs	0	0
71–100 yrs	6	6
100–200 yrs	10	7
200+ yrs	2	1
Deciduous riparian	0	1

tana were estimated to range from 200 to over 400 ha (McClelland 1979), the upper limit being similar to summer home range sizes in this study. Forest characteristics probably vary between study areas and may account for different home range sizes. With the exception of Renken and Wiggers (1989), other researchers did not use radio telemetry and may have underestimated home range size.

Schoener (1968) suggested intraspecific variation in territory size of birds could reflect resource availability; in areas where primary habitats are sparsely distributed, species would use larger territories. Renken and Wiggers (1989) found that pileated woodpecker territory size declined as log and stump volume, and canopy cover within the territories increased. McClelland (1979) speculated that home range sizes of pileated woodpeckers in Montana were largest in areas with a low proportion of mature forest because the birds needed larger areas to have adequate foraging habitat. Our data for individual birds do not support these suggestions. McClelland also recommended a minimum of 200 ha of suitable feeding area should be maintained within a 400-ha planning unit to sustain pileated woodpeckers in Montana. These area recommendations are at the low end of the range used by individual birds in our study.

We speculate that members of pairs of pileated woodpeckers with young may use different home ranges than their mates because food or other resources within the home ranges of individual pileated woodpeckers may become limiting while rearing young (Fig. 1). More resources would be needed to support 4 or 5 birds than 2 birds. This could have important consequences in terms of managing for reproductive pairs of pileated woodpeckers. Although our information on home ranges of pairs of pileated woodpeckers is limited, we feel we observed an important phenomenon which merits further investigation.

Habitat Use

McClelland (1979) stated that pileated woodpeckers would be eliminated from the northern Rocky Mountains if old-growth forests were liquidated. In western Oregon, it appears old-growth forests are not necessary to support pileated woodpeckers; the old-growth class was not available within the home range of 57% of the birds we monitored. Birds used habitats younger than old-growth forests for nesting, roosting, and foraging. However, as a result of lower forest productivity in the Rocky Mountains, trees do not become large enough for nesting and roosting by pileated woodpeckers for 140–200 years. Douglas-firs in the Rocky Mountains average 38–63 cm diameter at breast height at 200 years, and ponderosa pine (*Pinus ponderosa*) averages 40–61 cm diameter at breast height at 140 years (Buttery and Gillam 1984).

Our evaluation of habitat use indicates that forest habitat classes older than 40 years and deciduous riparian areas provide habitat for foraging and other diurnal activities of pileated woodpeckers, but not for nesting or roosting. Trees and snags in Douglas-fir stands in our study area were not large enough to accommodate pileated woodpecker cavities in stands younger than 70 years because diameter at breast height of trees averaged less than 50 cm according to yield tables (Curtis et al. 1982).

MANAGEMENT IMPLICATIONS

Pileated woodpeckers may not be a good management indicator species for mature forest habitats in western Oregon because the birds use immature (<70 years of age) forest stands. Consequently, their presence may not necessarily indicate that adequate habitat exists for other species which may have a stronger association with mature forest habitats. Also, the validity of the indicator species concept has been questioned (Block et al. 1987, Landres et al. 1988). Morrison (1986) specifically criticized the use of birds as indicators of changes in vegetation types. A species should only be used as an indicator of environmental change after controlled experimentation proves the indicator to be valid (Morrison 1986, Block et al. 1987, Landres et al. 1988).

Current management guidelines for pileated woodpeckers (USFS, Pacific Northwest Region) recommend that at least 120 ha (300 acres) of mature forest greater than 80 years old should be allocated for nesting within a 400 ha (1,000

acre) habitat area. An additional 120 ha (300 acres) of any age class should be designated as foraging habitat (F. M. Sirmon, Region 6, USFS, unpubl. data, 1983; USFS, Region 6, unpubl. data, 1986). These guidelines are based on data from east of the Cascade Mountains that were not collected by radio telemetry. The recommended acreages are smaller than averages for individual pileated woodpeckers in our study. Our results are based on data for individual pileated woodpeckers and collected during only part of the post-fledging period. Until sufficient home range information is available for breeding pairs throughout the year, we recommend increasing the areas managed for these birds beyond the mean values presented in this paper. Based on our observations, a 50% increase seems reasonable. We support Conner's (1979) recommendation that management should be directed towards providing habitat close to the mean used by a species rather than the minimum because we feel that there is a better likelihood of successful occupancy of the provided habitat.

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USE OF WINTER BIRD FEEDERS BY BLACK-CAPPED CHICKADEES

MARGARET C. BRITTINGHAM,¹ Department of Wildlife Ecology, University of Wisconsin, Madison, WI 53706

STANLEY A. TEMPLE, Department of Wildlife Ecology, University of Wisconsin, Madison, WI 53706

Abstract: Bird feeding is widespread and a frequent component of urban wildlife management; however, no data on how individuals use the resource or what it contributes to their energy needs are available. Consequently, we studied the foraging behavior of 348 color-banded black-capped chickadees (*Parus atricapillus*) at winter bird feeders in Wisconsin, from 1983 to 1985. Chickadees obtained approximately 21% of their daily energy requirements from the feeder. Individuals with home ranges close to the feeder used it more heavily ($P < 0.001$) than those with home ranges at greater distances. The number of chickadees visiting the feeder and their feeding rate were higher ($P < 0.001$ and $P < 0.025$, respectively) prior to sunset than in the morning. Feeder use did not differ ($P > 0.100$) between males and females or adults and juveniles. Feeders were used the most in autumn and the least in spring, and ambient temperature had no effect ($P > 0.200$) on the use of feeders. Although chickadees depended primarily on natural food sources, feeders provided an important supplement to their natural diet.

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Over 82 million people throughout the United States feed birds during the winter and disperse over 1 billion pounds of seed annually (U.S. Fish and Wildl. Serv. 1988), making this

activity one of the most common wildlife management practices being conducted today. Although numerous books and articles have been written on bird feeding, the majority describe how to feed birds, types of feeders and seeds, and the food preferences of different species (e.g., Arbib and Soper 1971, Geis 1980, Mahnken 1983, McElroy 1985, Dennis 1986). We lack

¹ Present address: School of Forest Resources, Ferguson Building, The Pennsylvania State University, University Park, PA 16802.